AMENDMENTS TO THE CLAIMS

Claim 1 (Currently Amended): A method for providing a hydrogen separation membrane upon a porous metallic substrate, comprising;

providing the substrate having a surface;

subjecting said surface to at least one surface treatment comprising a polishing step whereby the surface is smoothed and whereby bulk properties of the substrate remain unchanged; and

forming said hydrogen separation membrane upon said surface of the substrate by performing a plurality of deposition cycles, each deposition cycle comprising

disposing upon said surface a composition~~; and~~ ,

forming a coating on said surface of the substrate by a laser direct-write process utilizing said composition,

subjecting the coating to soft baking, and

subjecting the coating to sintering;

wherein said hydrogen separation membrane ~~coating~~ provides permeance of hydrogen therethrough~~, thereby forming said hydrogen separation membrane upon said substrate; and~~

~~subjecting said coating to thermal processing~~;

wherein said composition is a metallic ink having a metallic component and a carrier component, said metallic component comprising at least at least one of palladium, a palladium alloy, and a palladium and silver alloy;

wherein the soft baking substantially removes the carrier component from the coating; and

wherein the sintering substantially densifies and mends the metallic component of the coating to provide substantially complete coverage of the surface without substantial openings or defects in the coating.

Claim 2 (Cancelled).

Claim 3 (Previously Presented): The method of claim 1, wherein said composition providing said coating is comprised of at least one of palladium or palladium alloy.

Claim 4-7 (Cancelled).

Claim 8 (Previously Presented): The method of claim 1, further comprising the step of providing a diffusion barrier upon said surface after subjecting said surface to said surface treatment, wherein said diffusion barrier is configured to allow diffusion of hydrogen and prevent diffusion of intermetallic constituents.

Claim 9 (Previously Presented): The method of claim 8, further comprising the step of etching said provided diffusion barrier prior to disposing said composition upon said surface.

Claim 10 (Previously Presented): The method of claim 1, wherein said polishing step utilizes a method selected from the group consisting of shot peening, ion-beam treatment, plasma deposition of metals and vapor deposition of metals.

Claim 11 (Cancelled).

Claim 12 (Original): The method of claim 9, wherein said etching step employs etching with at least one of nitric acid, hydrochloric acid and pickling solutions.

Claim 13 (Cancelled).

Claim 14 (Cancelled).

Claim 15 (Cancelled).

Claim16 (Currently Amended): The method of claim 1, wherein ~~said coating providing~~ said hydrogen separation membrane, disposed upon said substrate, is less than about 20 microns thick.

Claim 17 (Currently Amended): The method of claim 1, wherein ~~said coating providing~~ said hydrogen separation membrane, disposed upon said substrate, is about 2 to about 10 microns thick.

Claim 18 (Currently Amended) The method of claim 1, wherein ~~said coating providing~~ said hydrogen separation membrane, disposed upon said substrate, is about 5 to about 10 microns thick.

Claim 19-20 (Cancelled).

Claim 21 (Previously Presented): The method of claim 1, wherein said metallic component of said metallic ink is produced by an aerosol decomposition process.

Claim 22 (Previously Presented): The method of claim 1, wherein said metallic component has a palladium content of about 70 to about 78% by weight.

Claim 23 (Previously Presented): The method of claim 1, wherein said metallic component has a palladium content of about 75 to 77% by weight.

Claim 24 (Cancelled).

Claim 25 (Previously Presented): The method of claim 1, wherein said metallic component of said metallic ink comprises about 25% palladium and silver mix and about 75% carrier, by weight respectively, wherein said palladium and silver mix is provided in a ratio of about 75% palladium to about 25% silver, by weight respectively.

Claim 26 (Previously Presented): The method of claim 1, wherein said metallic component of said metallic ink comprises about 5% to 50% palladium and silver mix and about 50% to 95% carrier, by weight respectively, wherein said palladium and silver mix is provided in a ratio of about 70% to 78% palladium to about 22% to 30% silver, by weight respectively.

Claim 27 (Currently Amended): The method of claim [[15]] 1, wherein at least one of said ~~thermal processing~~ soft baking and said sintering is carried out in an environment having a partial pressure of oxygen between about 10^{-2} atm and 10^{-5} atm.

Claim 28 (Currently Amended) The method of claim [[15]] 1, wherein at least one of said ~~thermal processing~~ soft baking and said sintering is carried out in a lean hydrogen gas atmosphere having less than about 10% hydrogen by weight.

Claim 29 (Currently Amended): A hydrogen separation membrane comprising:

a coating disposed upon a surface of a substrate;

wherein said coating transports hydrogen;

wherein the substrate is of a porous metal, said surface of the substrate being polished by a surface treatment whereby the surface is smoothed and whereby bulk properties of the substrate remain unchanged;

wherein said coating is provided to said substrate by a laser direct-write process utilizing a metallic ink having a metallic component and a carrier component, said metallic component comprising at least at least one of palladium, a palladium alloy, and a palladium and silver alloy; and wherein said coating is subject to thermal processing; and

wherein the thermal processing comprises

soft baking, the soft baking rendering the coating substantially free of the carrier component, and

sintering, the sintering rendering the metallic component densified and mended to provide substantially complete coverage of the surface without substantial openings or defects in the coating.

Claim 30-32 (Cancelled).

Claim 33 (Previously Presented): The hydrogen separation membrane of claim 29, wherein said polished substrate is treated to include a diffusion barrier between said polished substrate and said coating, wherein said diffusion barrier is configured to allow diffusion of hydrogen and prevent diffusion of intermetallic constituents.

Claim 34 (Previously Presented): The hydrogen separation membrane of claim 33, wherein said diffusion barrier is etched.

Claim 35 (Previously Presented): The hydrogen separation membrane of claim 29, wherein said polishing is accomplished by at least one of shot peening, ion-beam treatment, plasma deposition of metals and vapor deposition of metals.

Claim 36 (Cancelled).

Claim 37 (Previously Presented): The hydrogen separation membrane of claim 29, wherein said coating has a thickness of less than about 20 microns.

Claim 38 (Previously Presented): The hydrogen separation membrane of claim 29, wherein said coating has a thickness of between about 2 to 10 microns.

Claim 39 (Cancelled).

Claim 40 (Previously Presented): The hydrogen separation membrane of claim 29, wherein said metallic component of said metallic ink is provided by an aerosol decomposition process.

Claim 41 (Previously Presented): The hydrogen separation membrane of claim 29, wherein said metallic component of said ink is comprised of an alloy having between about 70 to about 78% palladium by weight.

Claim 42 (Previously Presented): The hydrogen separation membrane of claim 29, wherein said metallic component of said ink is comprised of an alloy having between about 75 to about 77% palladium by weight.

Claim 43-44 (Cancelled).

Claim 45 (Previously Presented): The hydrogen separation membrane of claim 29, wherein said metallic component of said metallic ink is comprised of about 25% palladium and silver mix and about 75% carrier, by weight respectively, wherein said palladium and silver mix is provided in a ratio of about 75% palladium to about 25% silver, by weight respectively.

Claim 46 (Previously Presented): The hydrogen separation membrane of claim 29, wherein said metallic component of said metallic ink is comprised of about 50% palladium and silver mix and about 50% carrier, by weight respectively, wherein said palladium and silver mix is provided in a ratio of about 70% palladium to about 30% silver, by weight respectively.

Claim 47 (Currently Amended): The method of claim 1 ~~or 14~~, wherein said ~~thermal processing includes at least one of organics bake out and~~ sintering comprises localized sintering of the coating and not an underlying support, wherein said localized sintering of the coating utilizes an ion or laser beam.

Claim 48 (Previously Presented): The method of claim 1, wherein said substrate is cylindrical or tubular.

Claim 49 (Previously Presented): The hydrogen separation membrane of claim 29, wherein said substrate is cylindrical or tubular.

Claim 50 (Newly Added): The method of claim 1, wherein the plurality of deposition cycles comprises three deposition cycles.

Claim 51 (Newly Added): The method of claim 1, wherein the plurality of deposition cycles comprises five deposition cycles.

Claim 52 (Newly Added): The method of claim 1, wherein subjecting the layer of the coating to soft baking comprises soft baking at about 150 degrees C to less than about 350 degrees C.

Claim 53 (Newly Added): The method of claim 1, wherein subjecting the coating to sintering comprises sintering the coating at about 850 degrees C to about 1000 degrees C.

Claim 54 (Newly Added): The method of claim 1, wherein subjecting the coating to sintering comprises

heating at a rate of about 3 degrees C per minute;

soaking; and

cooling at a rate of about 3 degrees per hour.

Claim 55 (Newly Added): The method of claim 1, wherein subjecting the coating to sintering comprises

heating at a rate of about 10 to about 100 degrees C per minute; and

soaking for about 2 to about 10 hours at about 900 degrees C to about 1000 degrees C.

Claim 56 (Newly Added): The method of claim 1, wherein the formed hydrogen separation membrane substantially uniformly covers the surface edge-to-edge.

Claim 57 (Newly Added): The hydrogen separation membrane of claim 29, wherein the sintering comprises localized sintering which sinters the coating and not an underlying support, wherein said localized sintering of the coating utilizes an ion or laser beam.

Claim 58 (Newly Added): The hydrogen separation membrane of claim 29, wherein the coating substantially uniformly covers the surface of the substrate edge-to-edge.